

HAER No. HI-41

Auwaiakeakua Bridge
(Auwaiakekua Gulch Bridge)
Mamalahoa Highway spanning 'Auwaiakekua Gulch
Waikoloa, South Kohala District
Hawaii County
Hawaii

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
San Francisco, California

HISTORIC AMERICAN ENGINEERING RECORD

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Location: 'Auwaiakeakua Bridge is located on the Māmalahoa Highway, 0.12 miles west of Waikoloa Road, in Waikoloa, South Kohala District, Hawai'i Island, Hawai'i. U.S.G.S. Nohonaohae Quadrangle, Hawai'i; 7.5 minute series, scale: 1:24,000. Universal Transverse Mercator (UTM) Coordinates: 05-214940-2200160.

Present Owner: State of Hawai'i, Department of Transportation, Highways Division.

Present Use: Highway bridge.

Significance: The 'Auwaiakeakua Bridge was constructed along the Māmalahoa Highway in 1940 by the Territory of Hawai'i to span the deep 'Auwaiakekua Gulch and its intermittent waterway. The project utilized Federal-aid funds allocated for the upgrading of the Hawai'i Island belt road system in the 1930s. The Māmalahoa Highway was the primary circum-island belt road until a new coastal road (the Queen Ka'ahumanu Highway) was completed in the 1970s (Inaba 1997). The bridge is a rare surviving example of a once common structural type—the timber stringer bridge—and typifies bridges built by the Territorial government in the immediate pre-World War II period. The bridge also represents the "work of a master"; William R. Bartels of the Territorial Highways Department. Bartels was responsible for the design of all major Territorial bridge projects between 1932 and his retirement from the department in 1956. The contractor, Otto Medeiros, built many other Federal-aid bridges on the island of Hawai'i.

The 'Auwaiakeakua Bridge and roadway were constructed at a cost of \$154,710.10; this cost also included the construction of two nearby bridges: the Ke'āmuku and Popoo Bridges. The South Kohala region is sparsely populated but the roadway and bridges were needed to accommodate major economic activities, such as ranching and farming. The bridge and roadway contributed to the economic development of the Kona (leeward) side of the island by providing reliable vehicular access between Kona-area ranches and the harbor at Kawaihae.

The 'Auwaiakeakua Bridge is a striking example of the Federal-aid bridges constructed by the Territory in the 1930s-40s. At nearly one hundred feet long, the bridge was one of the most impressive of the timber stringer bridges built by the Territory in the immediate pre-WWII era. Although concrete was the preferred material for bridge construction in the 1930s, the failure of the territorial legislature to match federal funds led to a significant reduction in money available for bridge construction by the end of the decade (Hawai'i [Territory], Dept. of Public Works, 1940: 27-28). A scarcity of concrete, caused by the massive build-up in Hawai'i for World War II, may have been another factor in the choice of timber. Very few of these large timber bridges remain as a result of the State of Hawai'i, Department of Transportation's policy to replace timber bridges with permanent, low-maintenance concrete structures.

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Name:
Hawaii's bridges are generally named for the feature that they cross; in this case, the 'Auwaiakewa Gulch. 'Auwaiakewa means "watercourse of the god" (Pukui et al., 1976). The name "AUWAIKEAKUA" is stenciled on the interior of the north end of the upstream rail. This alternate spelling—ending in "akua" (meaning "god"), rather than simply "kua"—is found on Territorial and State Records, as well as in the *Historic Bridge Inventory: Island of Hawaii* prepared by Patricia Alvarez in 1987.
2. Date of erection:
1940, according to the *Historic Bridge Inventory: Island of Hawaii* (Alvarez, 1987). This date is confirmed by the *Bridge Inventory* prepared by the Territorial Highway Department in cooperation with the U.S. Department of Commerce, Bureau of Public Roads in 1951; and the *Structure Inventory and Appraisal Sheets for Bridges Built Before 1940* (computer printout known as the State Bridge Inventory) on file with the DOT Highways Division.
3. Architect/Engineer:
William R. Bartels, chief designer for the Territorial Highway Department.
4. Builder, contractor, suppliers:
Otto Medeiros, contractor.
5. Original and subsequent owners:
Territorial Highway Department (1940-59); State of Hawaii, Department of Transportation, Highways Division (1959-present).
6. Original plans and construction:
The original drawings for "Bridge No. 3, Hawaii Belt Road, F.A.P. 10c(1)" were prepared by the Territorial Highway Department in January 1939. With the exception of the minor repair work identified below, the bridge appears unchanged from this time.
7. Additions and alterations:
Metal guard rails were added to the approach side of each rail (sometime prior to 1986). A long crack in the lava-rock (basalt) abutment on the south-east side of the bridge was patched with concrete (date unknown).

B. Historical Context:

1. Design and Construction of Bridges and Roads in Hawai'i, Pre-History to 1941:
 - a. Background:
Hawai'i's socio-political history may be divided into four general divisions (1) Polynesian (Pre-western contact: ca. 500 AD. to 1778); (2) European Discovery (1778 - 1810); (3) Hawaiian Monarchy (King Kamehameha 1810 to Queen Lili'uokalani 1893); and (4) Modern Period (Provisional Government—Republic of Hawai'i—Territorial Status—Statehood: 1893 to present). Historic bridges remain from only the modern period. Hawai'i Island contains by far the greatest number of historic bridges in the state,

perhaps due to its rural nature and consequent lack of development, and an abundance of land for alternate transportation routes without the destruction of older bridges and roads.

Initially, road and bridge-building in Hawai'i developed in conjunction with the westernization of the islands in the early nineteenth century. Timber and stone were the prevailing bridge construction materials at this time. Stone was abundant in Hawai'i, but construction of stone bridges required skilled labor, which was scarce in the islands. Wood was the cheapest material, and many types (including native hardwoods and North Pacific pine) were available. These pioneering bridges were unfortunately vulnerable to termite damage and floods. In an attempt to provide low-cost, permanent replacements for timber structures, steel truss bridges were imported from the United States by the Kingdom as early as 1884 (Alvarez 1987: 29). For shorter spans, concrete slabs were the preferred solution, but at this date, concrete bridges that could achieve longer spans were beyond the available engineering and construction technology. Nonetheless, maintaining steel bridges proved too costly in Hawai'i's corrosive marine environment, and they were soon rejected for government roads (Alvarez 1987: 39-40).

After the overthrow of the Hawaiian monarchy in 1893, the independent Republic of Hawai'i looked to the United States for annexation. Hawai'i became an American territory in 1898. During the Kingdom, road and bridge construction was primarily undertaken by day laborers and prisoners. However, in 1896-97, contracts were let for a belt road on the Island of Hawai'i, the first time such a system was used extensively, resulting in the construction of hundreds of miles of roads on that island.

b. Bridge Construction During the Early Territorial Period (1898-1924):

The Hawaiian Islands were annexed by the United States in 1898. Seven years later, the Territorial Legislature established the county governments on the separate islands, granting them taxing and spending powers in their jurisdictions. Nonetheless, the counties still relied on legislative appropriations to supplement county funds for internal improvements, thus county road-building was closely tied to Territorial and Federal government largesse (Hawaii Heritage Center 1990: 5). Throughout much of the early twentieth century, the counties' road and bridge-building could not keep up with the islands' economic development and infrastructure needs.

In response to a chronic shortage of funds for belt road construction, the 1911 Legislature recommended the issuance of territorial bonds for belt road construction. A Loan Fund Commission, consisting of the Superintendent of Public Works, the County Chairman of the Board of Supervisors, and three county residents, was appointed to oversee the fund expenditures (Alvarez 1987: 59). Each county had its own bridge design department located within the County Engineer's office. Bridges along the belt roads were generally designed by the county engineers using Territorial Loan Funds. Many of the bridge engineers were technologically skilled and evidenced high aesthetic sensitivity. Most of Hawai'i's remaining historic bridges were constructed by the county governments using territorial funds.

The majority of bridges constructed with Loan Funds were short span reinforced-concrete deck girder or flat slab structures. In the first decade of the century, bridges were often as narrow as eight or nine feet; those on public roads averaged fourteen or sixteen feet. In 1911, The Loan Fund Commission established eighteen feet as its required road width, although sixteen feet was commonly used in rural areas. These specifications prevailed until the 1920s when they were expanded to twenty feet.

c. Bridge Construction in Hawai'i after 1925:

Beginning in 1916, in anticipation of its entry into World War I, the U.S. Congress appropriated funds to assist states in developing their transportation networks (Alvarez 1987: 67). Hawai'i, initially excluded from the Federal-aid system, received its first federal funds in 1925 and created the Territorial Highway Department (THD). Bridges were a special concern of the federal highway system, and the Territorial Highway Department began the systematic replacement of narrow and hazardous bridges. With ample funds, the THD began to straighten out the belt roads and build long, high bridges across the mouths of the valleys. Bridges constructed with Federal-aid dollars had longer spans and were more decorative than county financed bridges (Alvarez 1987: 73). Reinforced-concrete tee-beam bridges dominate this period, although a few rare examples of open-spandrel concrete arches remain.

After the outbreak of World War II in December 1941, the military constructed many miles of roads in Hawai'i (Alvarez 1987: 76). Civilian construction virtually halted as manpower and equipment were requisitioned by the military. In the post-war era, a sophisticated survey of the island's roads was completed by the Territorial Highway Department. This survey rated roads and bridges on a mathematical "sufficiency rating system" (Alvarez 1987: 80). Fewer than half of the Federal-aid system's roads got a passing grade. The "Hawaii Statehood Transition Bill" of 1959 made available millions of federal dollars for highway improvement and development. The State Department of Transportation (DOT) was established in January 1960. Hawai'i continued to benefit from regular federal aid, such as the Highway Beautification Act of 1965 and aid for secondary roads. During the implementation of these federally sponsored projects, many earlier, historic bridges were demolished and replaced by modern constructions.

2. 'Auwaiakeakua Bridge in the Context of Historic Property Types:

Simple timber stringer spans constitute the only extant wood bridge type in Hawai'i. Timber had been used for bridge construction since 1840 when the first bridges were built in the islands. Timber bridges were susceptible to washouts and decay, thus the earliest remaining wood bridge dates from 1924. The remaining examples of wood bridges are constructed of timber girders, often with masonry (basalt) pier footings and abutments, wood cribbing or trestles, and open horizontal wood board railings. Stringer spans usually measure twenty-five feet or less. Larger timber stringer bridges, such as the 'Auwaiakeakua Bridge, are generally located in the dryer areas over deep gulches and date from the immediate pre- and post WWII period (c. 1937 to 1947). Although concrete was generally the preferred material for bridge construction, many timber bridges were built after 1937 when the Territory ceased matching incoming federal funds. In addition, concrete and steel were in short supply due to the military construction boom as World War II approached. During this time, rubble masonry (basalt or "lava-rock"), a locally abundant material which had not been previously used on Federal-aid bridges, made a reappearance in the footings and abutments. Very few of these timber bridges remain in the islands as a result of the State of Hawai'i, Department of Transportation and county Departments of Public Works policy to replace timber bridges with permanent, low-maintenance concrete structures. Consequently, the few remaining timber stringer bridges stand as rare survivors of this once common bridge type.

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Construction type:
Multiple-span, timber stringer (girder) bridge.
2. Condition of fabric:
The overall condition of the bridge, piers and abutments is good.

B. Description:

1. Overall Dimensions:

number of spans:	5
total length of roadway:	99 feet
max. span(s):	19 feet
roadway width:	24 feet
height above gulch:	28 feet
2. Substructure:

The bridge has rubble masonry (basalt or "lava-rock") abutments and piers. Each of the four piers is approximately 4'-0" high including a 12" thick concrete cap and 40'-0" long; the sides are battered at 1/2" per foot. Steel reinforcing bars were cast into the piers and cap; and 7/8" diameter anchor bolts at 6'-0" on-center tie the wood members to the pier. Heavy timber bents, constructed of 12" x 12" vertical and horizontal members with 3" x 10" diagonal bracing, sit on wood bearing blocks on top of the piers. The outermost vertical posts are battered at 1" per foot. The timber substructure is tied together with 3/4" diameter bolts and 3/4" x 16" drift pins. Foot ladders were constructed from 2" x 4" wood scraps on the vertical members to provide access for maintenance.
3. Superstructure:

The superstructure consists of eleven 6" x 18" timber stringers at approximately 24" on-center. The stringers span between the timber bents with the ends overlapping.
4. Floor/decking:

Bituminous asphalt roadway on solid 2" x 6" wood decking. The wood members are stacked side-to-side rather than laid flat (resulting in a deck 6" thick).
5. Railings:

Horizontal wood railings from 4" x 8" and 3" x 8" members, with 12" x 12" guard rail posts.
6. Other features:

Wheel guards constructed from beveled 12" x 14" timbers protect the edges of the roadway.

C. Site:

The bridge sits on a trapezoidal shaped parcel measuring 99 feet by 27 feet, which is centered on the UTM point 05-214940-2200160. Included within this parcel are the bridge's superstructure, substructure, floor system, and approach spans.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

The original architectural drawings for this structure are located at the State of Hawai'i, Department of Transportation, Highways Division office at 869 Punchbowl Street, Honolulu, Hawai'i. The drawings for "Bridge No. 3, Hawaii Belt Road, F.A.P. 10C(1)" were prepared by the Territorial Highway Department in January 1939. ~~Archival quality photocopies of the original plans will be submitted along with this report.~~ An additional sketch of the structure was included in the *Territorial Bridge Inventory* (Bridge Data Sheets) prepared by the Territorial Highway Department in 1951. The bridge appears unchanged from this time.

B. Early Views:

No early views of this structure were located.

C. Bibliography:

Alvarez, Patricia. "A History of Road and Bridge Development on the Island of Hawaii" in *Historic Bridge Inventory and Evaluation: Island of Hawaii and A History of Road and Bridge Development on the Island of Hawaii*. Prepared for the State of Hawai'i Department of Transportation Highways Division with the U.S. Department of Transportation Federal Highway Administration, Honolulu, 1987.

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PART IV. PROJECT INFORMATION

The State of Hawai'i, Department of Transportation, Highways Division has developed plans to replace the 'Auwaiakeakua Bridge with a new structure designed to meet current engineering and roadway safety standards. A Memorandum of Agreement (MOA) regarding the demolition of the 'Auwaiakeakua Bridge was signed by the Advisory Council on Historic Preservation (ACHP), the Federal Highway Administration (FHWA), the Hawai'i State Historic Preservation Division (SHPD) and the Department of Transportation, Highways Division (DOT) in 1996. The MOA stipulated that prior to the demolition, the DOT will document the structure in accordance with Historic American Building Survey/Historic American Engineering Records (HABS/HAER) standards. The documentation will be submitted to the following agencies: (1) SHPO, (2) HABS/HAER Washington D.C., and (3) Hamilton Library at the University of Hawai'i at Manoa. Further, the new bridge is to overspan the existing foundation structure and the DOT will retain the existing basalt (lava rock) piers and abutments to the greatest extent possible. Preliminary plans prepared by the DOT in September 1996 indicate that the top of the abutments will be removed to accommodate the deck of the new single-span reinforced-concrete bridge, and that the lava rock piers are to be abandoned in-place.

This project was undertaken in September 1997 by Spencer Mason Architects, Inc., as a subcontractor to Inaba and Associates, Inc., of Hilo, Hawai'i. The historic architect for the project was Barbara Shideler, AIA of Spencer Mason Architects, who undertook the field investigations, 35 mm photography, research, and report writing. The large-format photographs were produced in accordance with HABS/HAER standards by David Franzen of Franzen Photography.

Figure 1. Location and site map.

